

Propulsion Systems

Aerodynamics of Joined-Wing Aircraft and Missiles

Research Areas

- Wind tunnel tests to determine the best joined-wing configurations relative to, for example, range extension, lift, drag, stability, weight savings, wing sweep, and wing stagger.
- Computational studies to compare with experimental results.



Recent Findings

Joined wing configurations have been considered for a number of aircraft, missile, and weapon applications. For example, the addition of wings on a smart glide bomb or a smart powered missile is a way to extend their range. One advantage of the increased range is less probability that the delivery aircraft will be hit or shot down by enemy fire. An approach for the use of joined wings on bombs or missiles is to employ wings that can be extended in flight.

Lift and drag characteristics of a joined wing missile model were obtained in the AFIT low-speed wind tunnel over a range of angles of attack from -4 to 13 deg. The wings had sweep angles of either 30 deg or 60 deg. Various configurations were tested and compared, but a best configuration could not be identified. Additional testing is desired after some design improvements to the joined-wing model and the wind tunnel are made.

Experimental Facilities

The AFIT 5-foot wind tunnel and/or the low-speed tunnel in the new AFIT laboratory facility are available for use.

For further information or to suggest a related thesis topic, please contact:

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Propulsion Systems

Analysis of Compressor and Turbine Aerodynamics

Research Areas

- 2-D compressor/turbine cascade
- unsteady flow fields
- turbo engine performance
- high speed aerodynamics

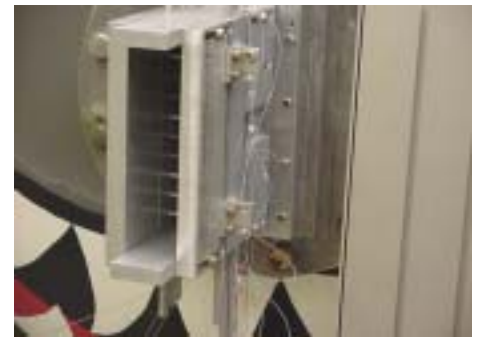
Recent Findings

Recent experiments were carried out in a continuous running tunnel known affectionately as the shark tank tunnel. The unsteady flow field upstream of rods shedding Von Karman vortices was measured with hot films and split films. The amplitudes and phases of the unsteady fluctuations are influenced by wall reflections and can be modeled only fairly by superposition of the potential flow solutions for a cylinder with periodic circulation and image cylinders placed outside the tunnel walls.



Experimental Facilities

A movable rod assembly sits at the exit of the shark tank plenum fed by a centrifugal blower rated at 3000 cfm. Inlet Mach numbers range from 0 to 0.5. The blower develops 1.6 psi total head at 2 lbm/s. X-hot films are position-controlled by an automatic traverse system tied into a PC driven controller. Other facilities include a linear turbine cascade, 5x engine scale for measurement of aerodynamic performance and heat transfer, a small-scale turbojet engine and a supersonic blowdown tunnel, Mach 1.5-5.



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Propulsion Systems

Passive and Active Control of Boundary Layers

Research Areas

The goal of this research is to conduct an experimental study for the application of microelectromechanical (MEMS)-based passive and active devices to control unsteady boundary layer flow separation in turbomachinery. Major areas include (more than one year of effort):

- A scaled-up model of a MEMS cantilever arrangement to investigate the influence and effect of the arrangement on the flow field and boundary layer flow over a flat plate under low-speed flow conditions.
- Expansion of the tests to include pressure gradients, geometric variations, and scaling down to MEMS devices.



12-in-square test section



Recent Findings

Preliminary tests indicate the AFIT Aerolab wind tunnel will provide reasonably uniform flow in the test section. Tests are about to begin on a flat plate model. Instrumentation and an automated data acquisition system are being developed.

Experimental Facilities

- The AFIT Aerolab 12-in-square cross section tunnel with speeds up to 150 mph that has a turbulence level below 0.25 percent. The tunnel allows for instrument and optical access to the test section.
- The AFIT five-foot wind tunnel and its associated test system located in Building 19 at Wright-Patterson AFB. The maximum Mach number is 0.26 with a maximum Reynolds number of 1.9×10^6 . The test section is five feet in diameter and 18 feet long.
- The AFIT low-speed wind tunnel that is presently under construction will have a maximum Mach number of approximately 0.3. It will have a test section of approximately 0.5 m x 0.5 m and it will have complete optical accessibility for laser diagnostics and surface imaging.
- The AFRL low-speed turbine cascade is capable of operation at elevated levels of freestream turbulence.

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